LINEARCORDER MARK VII

WR3310

MANUAL NO. WR3310-UM-151

USER'S MANUAL

BRISTOL LABORATORY 7/25/91

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INTRODUCTION

The WR3310 was developed by making fundamental improvements to the WR3101 Mark VII, making this recorder significantly easier to use, and greatly improving functions, performance, and reliability. The WR3310 can be used for a wide variety of applications in the various recording fields.

After removing the packaging, take time to carefully read this instruction manual. If power is applied to the recorder improperly, or if parts of the recorder other than those designated in this manual are dismantled, conditions dangerous to operators, or irreparable damage to the recorder may occur.

CAUTIONS BEFORE USE

- After Unpacking

  After the recorder has been unpacked, perform a visual inspection, referring to the table in Section 5-3 listing the quantities of accessories. If the recorder is damaged in any way, or shortages in accessories are discovered, contact your dealer.

- Recorder Installation Location

  The WR3310 should be installed on a horizontal base, indoors, in a normal interior environment.

  Avoid the following environmental conditions when selecting an installation location.

  - Locations with excessive dust, dirt, with saline atmospheres, or locations subject to corrosive gases
  - Locations where temperature or humidity exceed the specifications in this manual
  - Locations subject to direct sunlight
  - Locations subject to excessive vibration or shock
  - Locations subject to lightning or other surge voltages or EMI

- Power Supply

  Use a power supply within ±10% of the nominal voltage with a minimum line capacity of 10 A (for 100-V operation) and one that allows easy protective grounding.

CAUTION

There is a line voltage selector on the bottom panel of the WR3310 enabling it to be used at other than 100-V. It is extremely important to set this supply voltage selector to the conditions of the line to be used before performing any other operations.

- Recording Paper

  The WR3310 uses heat-sensitive paper. Features of the heat-sensitive paper such as coloring characteristic and surface smoothness exert a great influence on the quality of the recorded trace. Thus, it is extremely important to use only Graphtec's recording paper.

- Pens

  The pens should not be touched except when being replaced. Do not reduce pen pressure to extremely low levels, or allow the pen to rise up off the paper, as this may damage the pens.

- Data Storage

  Recording relies on a thermal reaction by the heat-sensitive paper. Observe the following precautions when handling recording data.

  - Do not place the paper in locations subject to direct sunlight.
  - Do not place the paper in locations subject to high temperatures (50° C or higher).
  - Paper should be kept in a location which is as dark as possible. If the recording data are stored under fluorescent light or under natural light, the recording density will deteriorate after a few months.
  - Do not store recordings inside vinyl chloride bags.
  - Do not place recordings on damp diazo copy paper.
  - Avoid contacting recordings with acids, alcohol, or ester ketones. These may cause discoloration.

- Pen Protection Function

  Pen heat source is turned off and pen motion is suspended to protect the pen tip under the following conditions.

  - When paper has run out
  - When the STOP button has been pressed to stop paper feed
  - When the pen lift lever has been pushed up to raise the pen off the paper

- Mounting Paper

  Check that the heat switch has been turned off, and if it has, mount the paper.

- Warning Beeper

  When the following conditions occur, a warning beeper sounds, the pen heat source is turned off, and pen drive is stopped.

  - When paper has run out
  - When the pen lift lever has been pushed up to raise the pen off the paper

- High-Frequency Input

  The accuracy of the servo system is only guaranteed if the servo amplifier is not saturated. Note that if frequencies higher than the pen response speed are input to the system, the amplifier will saturate.

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1. PARTS NAMES AND FUNCTIONS

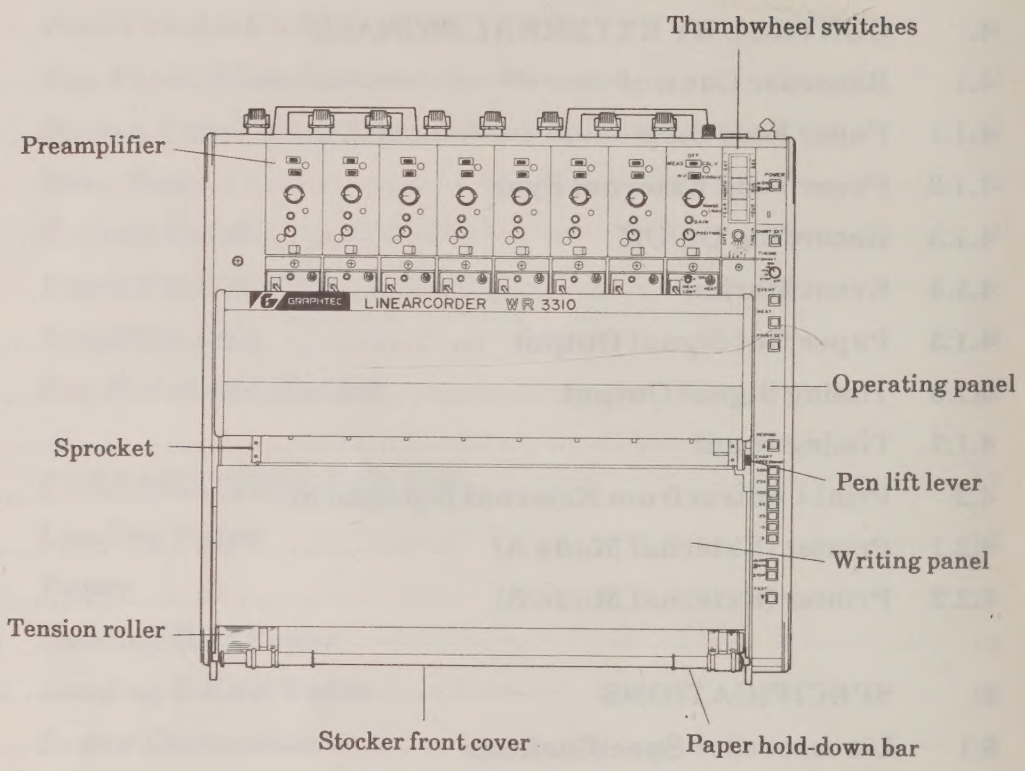


Fig. 1-1 Top Panel

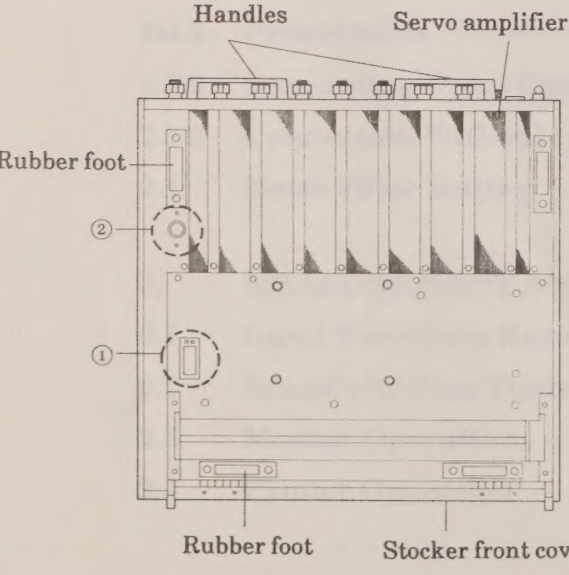


Fig. 1-2 Bottom Panel

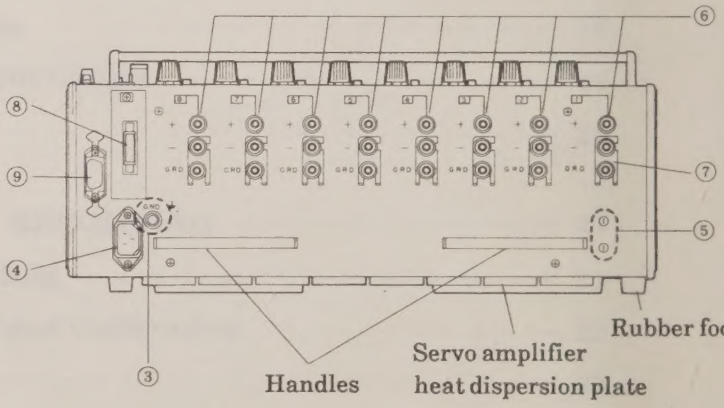


Fig. 1-3 Rear Panel

1.1 Top Panel When Horizontally Mounted

Fig. 1-1 is of the WR3310 Linearcorder top panel.

It shows the pen motors and preamplifiers for 8 channels, the markers and print head, and the control panel near the print head. There is a paper-holding roller on the writing panel side, and underneath that is the front cover for the paper storage area. This cover has been specially molded to enable a better grip when the recorder is being carried.

1.2 Bottom Panel When Horizontally Mounted

Fig. 1-2 shows the bottom panel when it is vertically mounted. The supply voltage selector and the fuse holder can be seen. Note that this side of the recorder is used for heat dissipation.

① Supply Voltage Selector

The system can be set up for the supply voltage of the line used by setting the white line at the center of the selector to the required numerical value. It is extremely dangerous to set this incorrectly.

② Fuse Holder

This can be pulled out by turning it counterclockwise with a Philips screwdriver. It is very important to only use a fuse of the specified rating when replacing the fuse.

1.3 Rear Panel (with Input Terminal Strip)

Fig. 1-3 shows the rear panel. All connections to external devices are made from this panel.

③ Protective Ground Terminal

This protective ground line terminal is provided to establish the same potential difference with ground for the metal parts of the recorder which operators might touch with their hands, such as those of the chassis. Apart from the chassis, the main power supply voltage transformer secondary neutral point and power supply connector protective ground are also connected internally.

④ Power Connector

The center conductor of this three-line input connector is the protective ground terminal. Note that only the dedicated power cable provided with the system may be connected here.

⑤ Reference Voltage Output Connectors

The black connector outputs the same voltage as the chassis and the red connector outputs +1 V ±0.2%. The output resistance is 200 Ω, and these are used for preamplifier sensitivity calibration.

⑥ Input Connectors

These input connectors are connected directly to their corresponding channel preamplifier inputs. The black G connectors are guard connectors, the red (−) terminal is a floating ground, and the red (+) terminal is the signal positive-side input terminal. The accessory input cables can be connected here.

⑦ Shorting Bar

The black G and red (−) terminals are connected to a metal fixture, and this operation is explained below.

⑧ Printing External Input Connector

This is used for input of character signals from an external keyboard to control the printer. See Section 4 below for details on the terminal strip.

⑨ External Control Signal Connector

This is used for input of external signals to control paper feed, pen heating, markers, and other operations. See Section 4 for details.

1.4 Control Panel

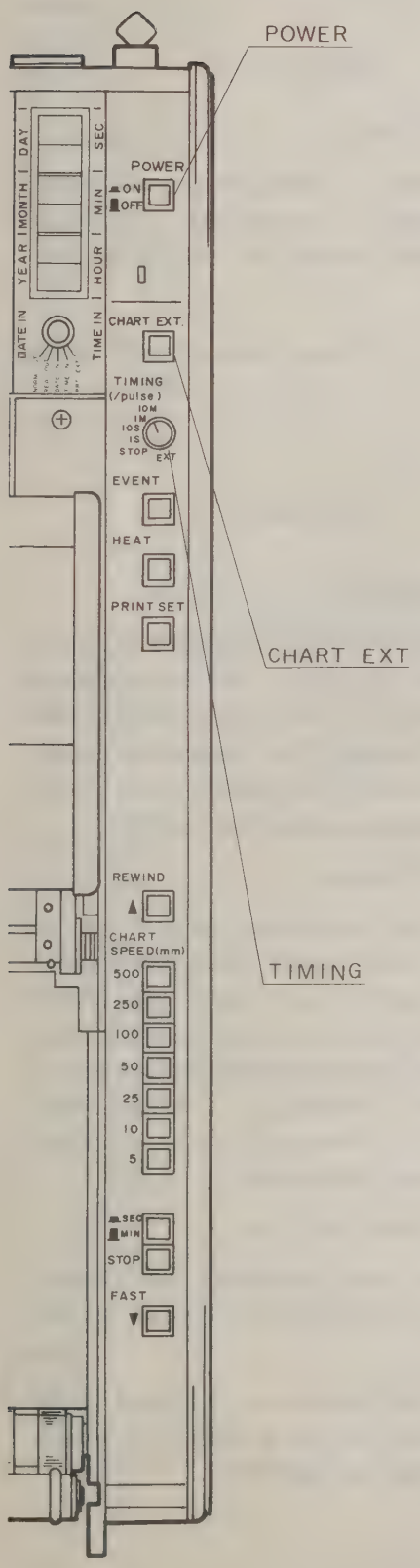


Fig. 1-4

POWER

This switch is pressed and locked to turn the power on, at which point the red lamp lights. It is pressed once again to turn power off, thereby extinguishing the red lamp.

PRECAUTIONS

Make the following checks before power is applied.

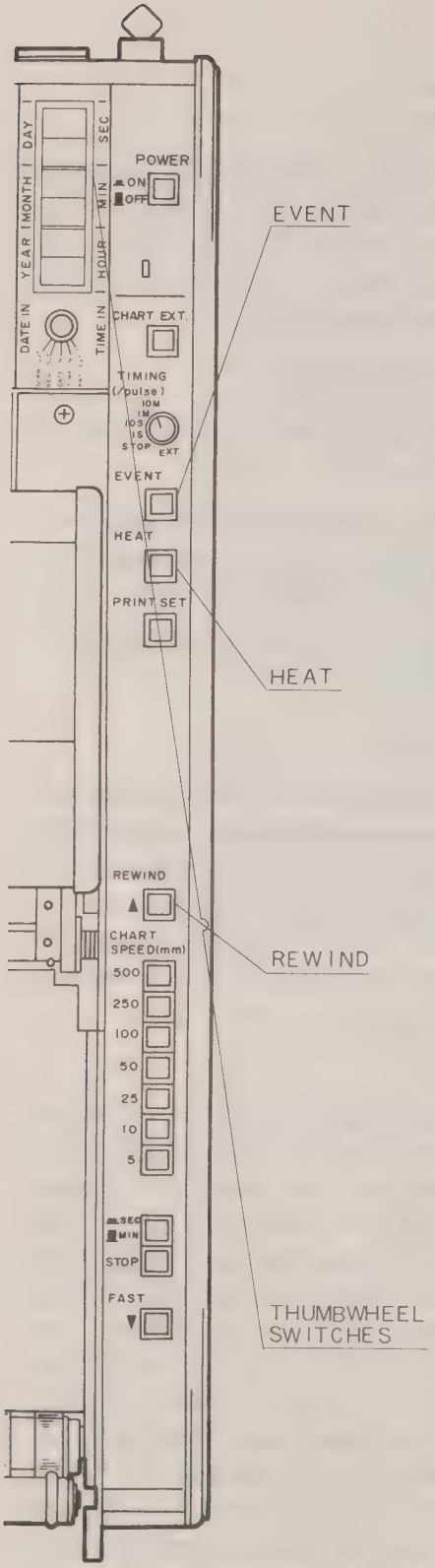
- The supply voltage selector on the rear panel should be set to the line voltage to be used.
- The STOP switch should be depressed.

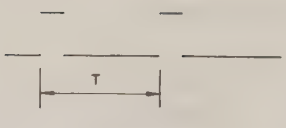
CHART EXT

This is the paper feed selection switch. When pressed and locked, paper is fed in sync with the external pulse signal. If pressed once again to release the lock, the CHART SPEED switch on the operating panel can be used to specify paper feed speed.

TIMING

This dial is used to select the generation frequency of the signal which operates the time marker. Timing pulses are generated at 10 min, 1 min, 10 s, or 1 s intervals according to the selection of 10M, 1M, 10S, or 1S. The corresponding pulse widths are approximately 7, 4, 0.7, and 0.2 s, respectively. These can also be output to external equipment via the external control signal connector ⑨. Press the STOP key to stop the timing pulse, and use EXT to send the signal input from an external device to the marker. (The pulse width is 0.7 s.)

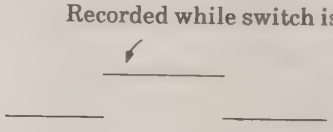




Timing mark

EVENT Switch

This switch is used to record event marks using a marker pen. The mark is recorded while the switch is depressed.



Event mark

HEAT Switch

This switch is used to control the heat source for all pens. When depressed and locked, if the other switch settings all satisfy the recording conditions, power is applied to the pens, and recording can be performed.

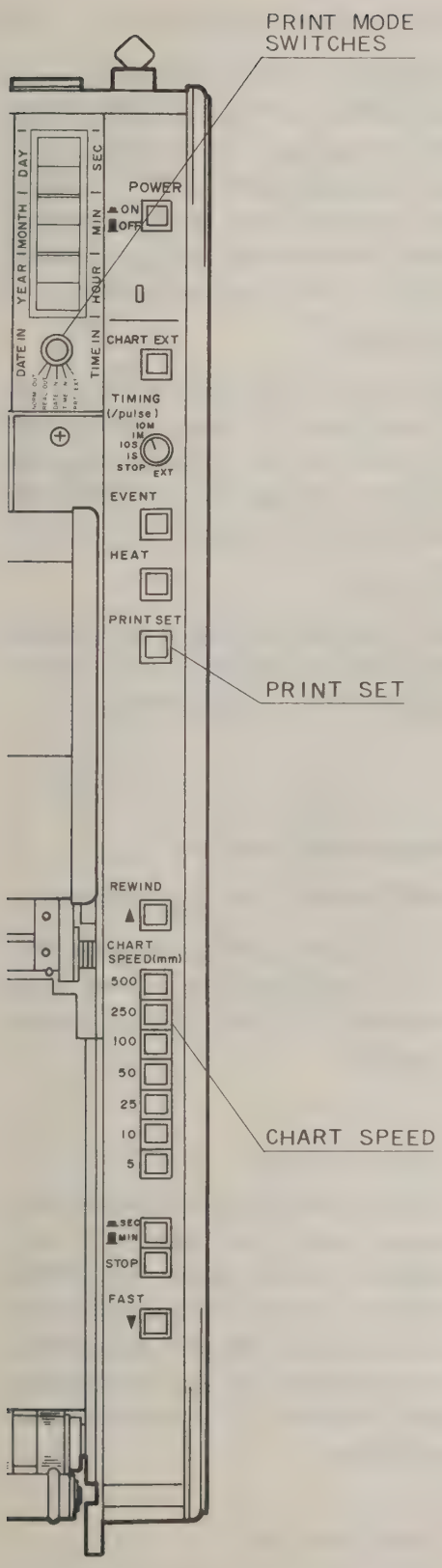
REWIND Switch

This is the recording paper rewind switch. This switch is only effective for roll paper, and when the STOP switch on the operating panel is depressed. When the REWIND switch is depressed, recording is suspended, and paper is rewound at a speed of approximately 100 mm/s.

Thumbwheel Switches

These are used to specify the numerical values for the data read to the printer.

The six digit switches are used to set year, month, and day, or hour, minute, and second data.



PRINT MODE Switches

These are used to select the printer mode.

NORM OUT: Operation time and other parameters are automatically recorded.

REAL OUT: Time, data, and other information is automatically recorded.

DATE IN: This is used to specify date (year, month, and day) data.

TIME IN: This is used to specify time (hour, minute, second) data.

PRT EXT: This is used to record character data received from external devices.

PRINT SET Switch

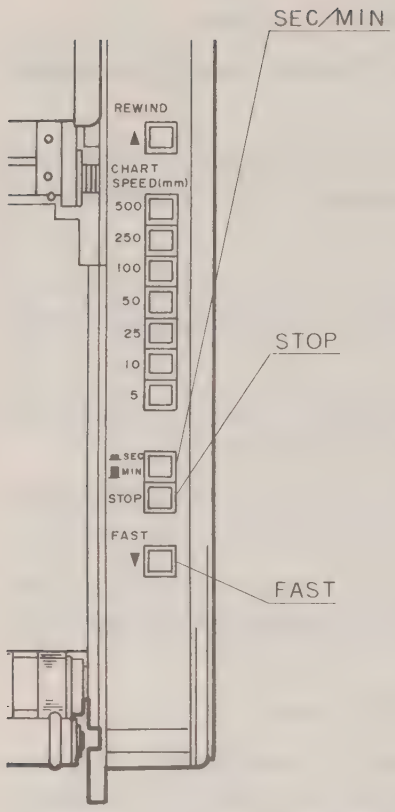
This switch is used to read date and time data to the printer. The data is read into the CPU when the switch is pressed.

This switch is used in combination with the printer mode switches and thumbwheel switches.

Note that it is only effective when the HEAT switch is off, or when paper is not being fed.

CHART SPEED Switches

These are used to select the speed of paper feed. They are effective when the CHART EXT switch on the operating panel is not depressed. Seven different speed settings can be made in the range 5 to 500. If none of the switches are depressed, the default speed is 5.



SEC/MIN Switch

This switch is used to select the units for paper feed. If it is depressed and locked, the second unit is selected and paper speed is specified in mm/s. When depressed once more to release the lock, the minute unit is selected and paper is fed in units of mm/min.

STOP Switch

This is used to stop paper feed. Paper feed is stopped by depressing and locking this switch. If it is pressed once more to release the lock, paper is fed at the specified speed.

FAST Switch

This is the paper fast-feed switch. Paper is fed at the maximum speed while this switch is depressed.

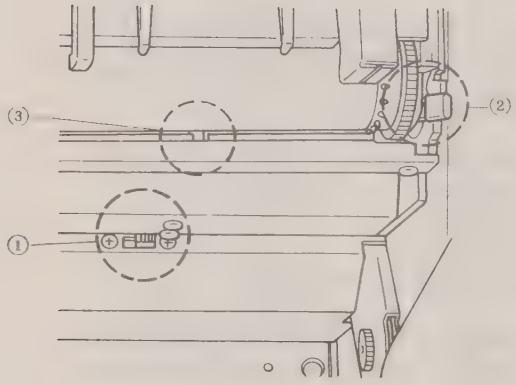


Fig. 1-5 Paper Feed Section Switches

1.5 Paper Feed Section

(1) Roll Paper/Z-Fold Paper Switch

If roll paper is used, set the switch to the roll position. Note that rewind of Z-fold paper is not possible.

(2) Pen Lift Lever

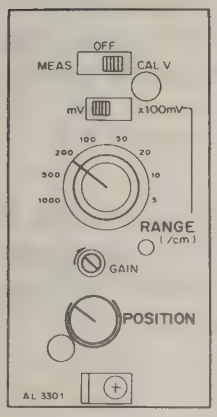
If this lever is pulled forward, the paper feed roller can be freely rotated. If the paper feed STOP switch is released while this lever is raised, the beeper will sound, and neither pen deflection nor any recording operation is performed.

(3) Paper Detector

A paper detector is provided and when paper runs out, a beeper sounds and recording is stopped.

1.6 Amplifier Unit

This DC amplifier is used to amplify minute input signals. There are two types of unit with different sensitivities.



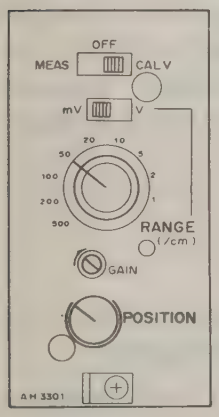


Fig. 1-6

MEAS. /OFF /CAL.V

This is used to turn input on and off and also for the calibration voltage.

MEAS.: The pen moves according to the input signal.

OFF: The input signal is not supplied to the pen.

CAL.: The calibration voltage is input.

If this switch is turned to the CAL.V setting, the amplifier input changes to ground, and the pen is deflected according to the internal voltage 20 mm (AL3301 and AH3301) or 40 mm (AL3302 and AH3302). This width is varied using the GAIN knob, as explained below.

mV/V (mV/×100 mV)

This switch is used to select the units for the RANGE numerical values as either mV or V units.

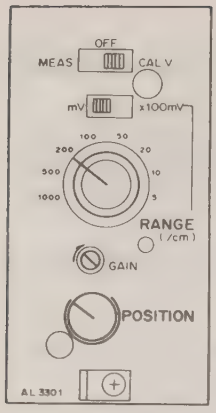
(For the AL3301, it switches between mV and ×100 mV units)

RANGE Switch

If the AH3301 preamplifier is used, this switch has the nine settings 1, 2, 5, 10, 20, 50, 100, 200, and 500 units/cm. If the mV/V is set to mV, then, for instance, if this is set to 5 (/cm), the sensitivity is expressed by saying that the pen has a deviation of 1 cm at 5 mV.

GAIN Switch

Located next to the RANGE dial, this is used to interpolate the stepwise variation in the sensitivity of the RANGE switch. Sensitivity increases as this dial is rotated clockwise and decreases as it is turned counterclock-



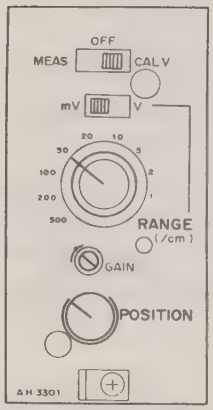


Fig. 1-6

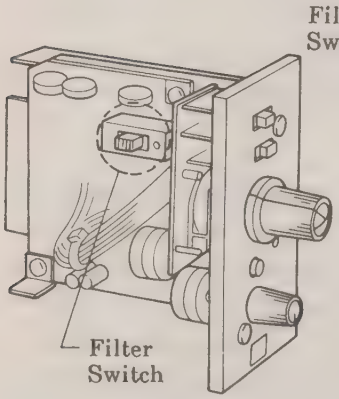


Fig. 1-7

wise. When changing the setting of the MEAS/OFF/CAL.V switch from off to CAL.V, if the setting is adjusted so that the pen is deflected 20 mm (AL3301 and AH3301), or 40 mm (AL3302 and AH3302), then the sensitivity is that selected by the RANGE dial.

POSITION Switch

This dial is used to specify the pen 0 position electrically. When the input is 0 V, the pen can deflect to any arbitrary full-scale position.

Amplifier Screw Cover

The amplifier holding screw is under this cover. It can be pushed to the left with the fingernail, and will then reveal the screw underneath. Remove this screw to take out the preamplifier.

Filter

This is used to eliminate line noise (hum) mixed with input signals.

If the preamplifier is removed, a switch labeled OFF, −20 dB, and −40 dB can be seen.

If this switch is set to either -20 dB or -40 dB, then the noise component will be reduced to 1/10 or 1/100, respectively.

The filter is built into the AL3301 and AH3301 preamplifiers.

Fig. 1-9 and Fig. 1-10 show standard characteristics for the WR3310 Linearcorder.

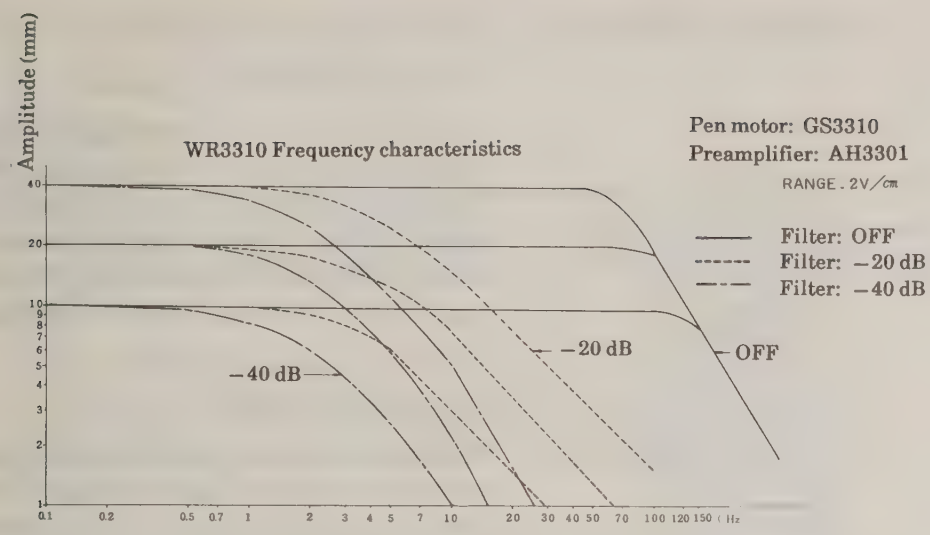
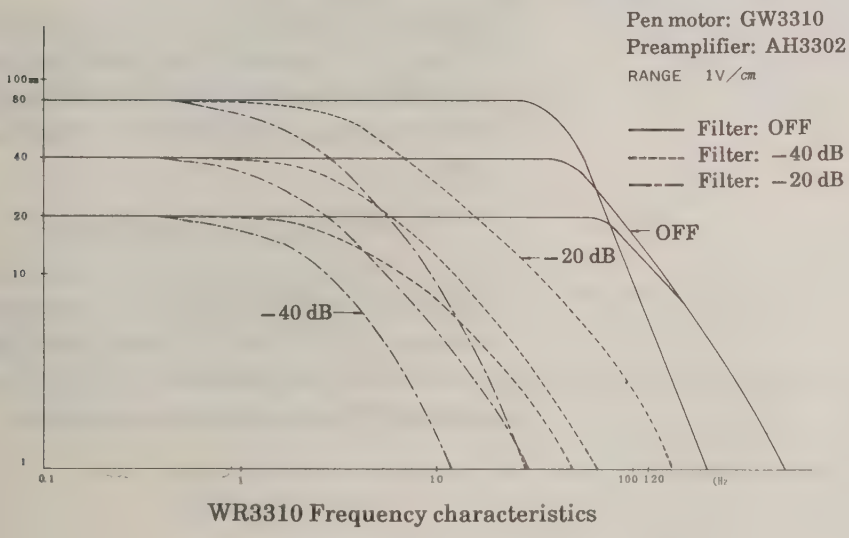


Fig. 1-8



WR3310 Frequency characteristics

Fig. 1-9

1.7 Pen Motor and Marker

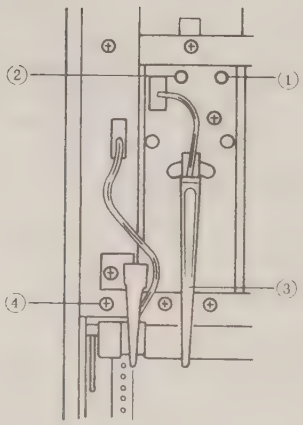


Fig. 1-10 Pen Motor and Marker

(1) HEAT Switch

When this switch is turned off, power to the thermal pen is turned off. Simultaneously, the servo amplifier input falls to ground, severing its connection with the preamplifier. This is used for alignment when replacing pens.

(2) Heater Control

This dial is used to adjust thermal pen coloring density. Line density increases as this is turned clockwise. Note that if the density is increased more than necessary, this may reduce the life of the pens.

(3) Thermal Pen

Extremely small heaters are attached to the pen tip, and when power is supplied to them, they immediately get hot forming a line on the thermal paper.

(4) Event Marker (Time Marker)

There are two heaters on the pen tip. Normally the heater on the sprocket hole side is on and is used to draw the baseline. The time marker on the opposite side performs in the same way.

2. PREPARATIONS FOR USE

2.1 Loading Paper

2.1.1 Paper

Both roll paper and Z-fold paper can be used with the WR3310. Types also differ according to pen deflection amplitude and the number of channels that can be accepted. In all cases, the length is 100 m.

PRECAUTIONS

It is extremely important to turn the power switch off and remove the power cord before mounting chart paper.

① The coloring characteristic varies greatly with the coloring agent used and the paper surface finish.

② Recording depends upon thermochemical effects, and consequently may be subject to discoloration if recordings are stored in locations exposed to direct sunlight, subject to high temperatures, or where they can be exposed to ultraviolet light.

③ Recordings are affected by vinyl chloride, diazo copies, acids, and alcohol.

PRECAUTIONS

① It is extremely important to use the paper specified by Graphtec.

② Avoid storage and use of the paper under extreme environmental conditions.

③ Do not place the paper on top of equipment that generates heat.

2.1.2 Loading Roll Paper

Use the following procedure to load roll paper.

① First, open the recording panel and the front panel. Take the roller shaft in both hands, and keeping it horizontal, pull it up and out.

② Set the roll paper/Z-fold paper switch to the ROLL side.

③ Put the roller shaft into the roll paper as follows.

- Turn the roller shaft ends around so that the flange on the end without the gear is in the right hand, and now turn it with the right hand counter-clockwise to remove it.
- Next, insert the roller shaft into the hollow shaft of the paper roll, check that the nut comes out the other end, and then screw on the flange just removed from the shaft to fix the paper roll on to the shaft.

④ Hold the roll so that the gear is to the right as shown in Fig. 2-2, then with one hand place the roll in the Linearcorder.

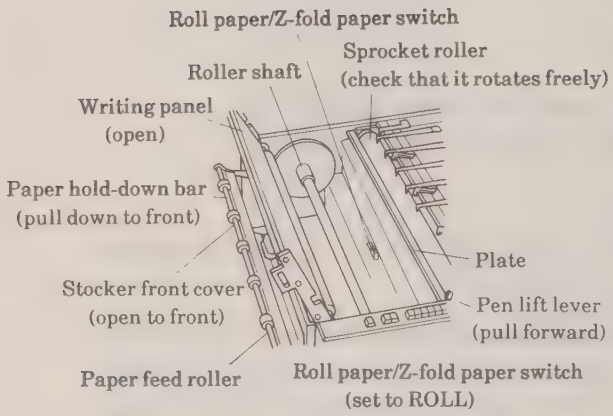


Fig. 2-1 Preparations for Loading Paper

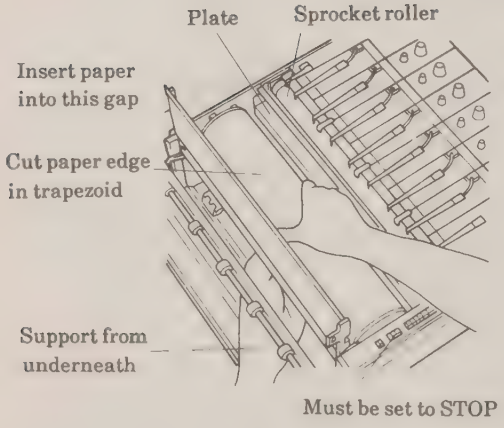
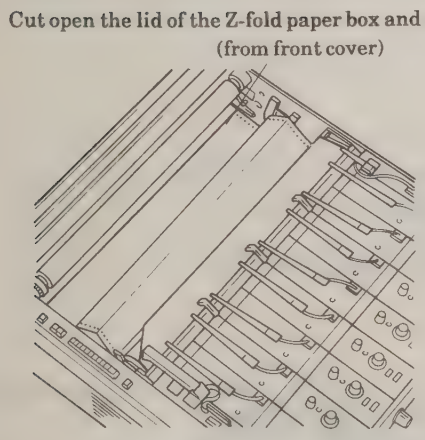


Fig. 2-2 Loading Roll Paper

2.1.3 Loading Z-Fold Paper



Note The roll paper/Z-fold paper switch must be set to Z FOLD.

Fig. 2-3 Loading Z-Fold Paper

① Remove the roller shaft as described above in the procedure for loading roll paper. (The roller shaft is not required when Z-fold paper is loaded.)

② Set the roll paper/Z-fold paper switch to Z FOLD.

③ Open the cover of the Z-fold paper box as shown in the illustration below, and now load the paper as shown in Fig. 2-3 above. (Insert the paper so that channel 1 is on the left-hand side.)

It is a good idea to open the front panel and then insert the paper. It will be easier that way.

2.1.4 Paper Setting

Once the paper is loaded, use the following procedure to set the paper in the Linearcorder.

① Pull the pen lift lever forward, so that the sprocket roller can be rotated freely. Take the front end of the paper in both hands and draw it over the top of the plate, passing it through the space between the sprocket rollers. Once the front end of the paper appears between the sprocket roller and the pen tip, take it in the hands again and pull it up so that it is attached to the sprocket. The sprocket on the left moves to right and left. Make sure that the paper is firmly attached to the sprocket. With the paper pulled out like this, return the pen lift lever to an appropriate setting. (Fig. 2-4)

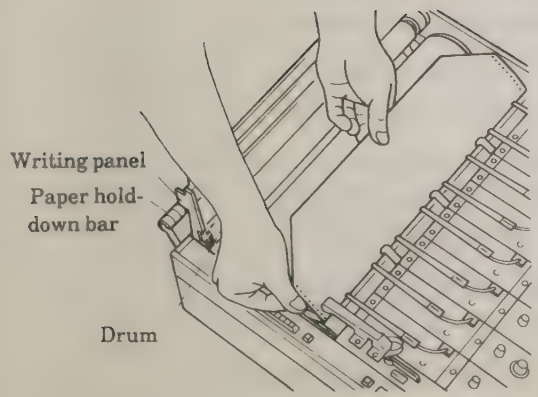


Fig. 2-4 Pull Out Paper

② Close the recording panel, and acclimatizing the paper to the top of the panel, push the paper hold-down bar forward and pull the paper through.

③ Now push the paper hold-down bar back to its original position.

PRECAUTIONS

Paper Rewind Operation

When rewinding the paper, remove the paper hold-down bar as shown in Fig. 2-5 and Fig. 2-6 below.

(See the description of the REWIND switch ⑲ above.)

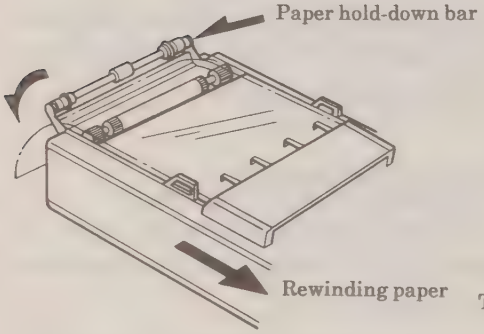


Fig. 2-5

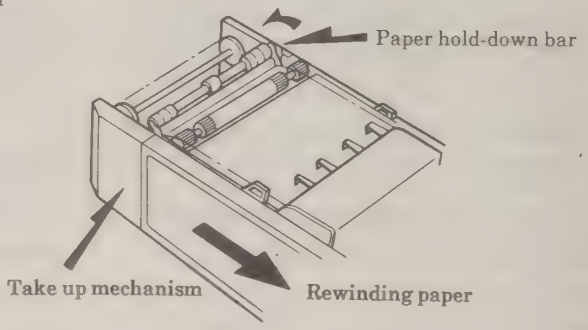


Fig. 2-6

2.2 Power Connection

2.2.1 Preparation

Make the following switch settings before connecting the power.

Switch	Setting
POWER	Off
CHART EXT	Off
HEAT	Off
STOP	Stop
Preamp MEAS/OFF/CAL.V	Off
Pen motor HEAT on/off	Off

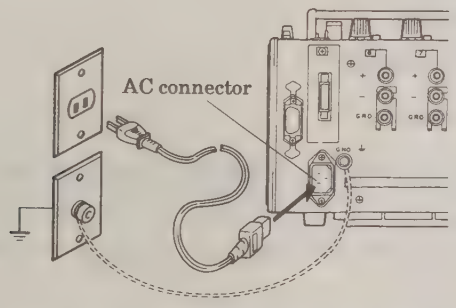


Fig. 2-7

2.2.2 Connection

Insert the plug of the accessory power cable into the AC line outlet. If the line does not have a protective ground conductor, do not forget to connect the ground line to the protective ground terminal.

Now follow the procedure below to complete the power connection.

① Turn the POWER on/off switch to on. The red indicator lamp will light, and the pen will be deflected slightly and will then return to its original position.

② In this condition, set the chart speed to an appropriate value, and perform the paper feed test.

③ Now turn the pen motor HEAT switch on, slowly release the CHART STOP switch and feed paper. Move the preamp POSITION switch, and check that the pen follows correctly.

④ Finally, turn the HEAT switch on the operating panel on, and check that the pen correctly draws the line.

This completes the procedure for power connection and application.

2.3 Connecting Input Lines

2.3.1 Preparation

① Make the following switch settings before making connections.

Operating Panel	
POWER switch	On
CHART EXT	Off
TIMING	Any setting
HEAT	Off
PRINT	Off
CHART SPEED	5mm/s
STOP	Stop
Preamplifier	
MEAS/OFF	Off
RANGE	Any value
mV/V (mV/×100 mV)	V (×100 mV)
Pen Motor	
HEAT	off

② Measure the voltage between the input signal source guard terminal (shielded side) and the WR3310 GRD terminal, and make sure there is no potential difference between them. If a clear difference is shown by the AC voltmeter, quit the connection procedure, determine the cause, and correct it.

③ Check the input waveform by another method (e.g., on an oscilloscope CRT), to make sure that it does not exceed 500 Vp-p, and also make sure that high-frequency noise is not superimposed on the signal.

④ For some input types, the shorting bar will have to be removed in advance.

2.3.2 Connecting Input Cables

Basically, the accessory input cables should be used for the signal lines. These cables are two-core insulated shielded lines with input plugs. Make the connection as shown in Fig. 2-8 so that the red line is connected to the (+) terminal, the white line is connected to the (−) terminal, and the shielded line is connected to the GRD terminal.

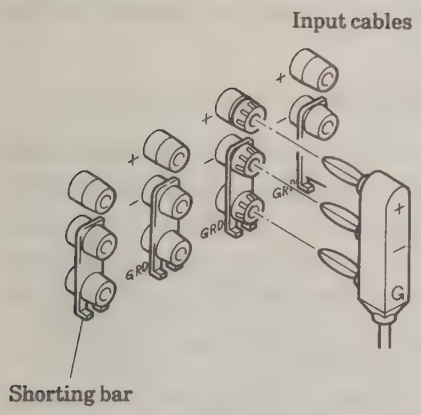


Fig. 2-8

CAUTION

If the above connections are reversed when connecting the accessory signal input line plug, if the shorting bar is attached, this may destroy the signal source equipment.

Connection with the signal source is usually made with the shorting bar attached and so that the (−) and GRD terminals are connected to the signal source ground side, while the (+) terminal is connected to its output side. However, in some cases measurement conditions may require the following types of connection (Fig. 2-9, Fig. 2-10, Fig. 2-11).

Observe the following cautions when connecting the signal line.

① The amplifier unit MEAS/OFF/CAL switch should be set to OFF.

② High-frequency signals should not pass between the signal source equipment output and the WR3310 protective ground terminal (GND) or to the input terminals (+, −, or GRD), neither should there exist voltages in excess of 500 V between these.

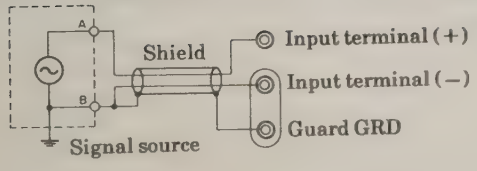


Fig. 2-9

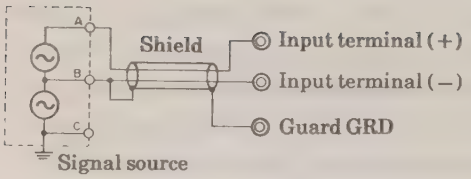


Fig. 2-10

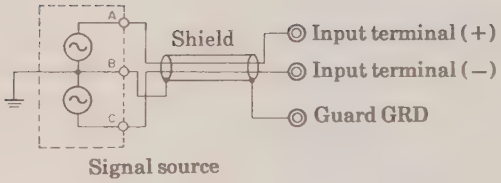


Fig. 2-11

Make connections as follows, according to the characteristics of the signal source.

- For regular signal sources, make the connections as shown in Fig. 2-9.

  (Shorting bar is not removed.)

- For signal sources with bias voltages, connect the side with low impedance with respect to ground to the - terminal, and make the connections as shown in Fig. 2-10.

  (Shorting bar is removed.)

- For signal sources with differential outputs, make the connections as shown in Fig. 2-11. In this case also, the side with the low impedance with respect to ground is connected to the (−) terminal.

  (Shorting bar is removed.)

2.3.3 Connection Without Input Cables

Observe the following cautions when making the connections without using the accessory input cables.

① The (+) and (−) signal lines should be laid along the same path. This will ensure balance of noise or hum induced in these lines. It will also ensure that the preamplifier common mode rejection (CMR) effect operates.

② If the input cable shielded line is used for connection between the signal source equipment and the recorder protective ground terminal, the hum current runs on the shielded line, and this may cause noise interference. Also, it is necessary to use an insulation shield to prevent pick-up of unnecessary contact voltages and hum currents.

2.4 Noise Filter Setting

This is used to eliminate line noise (hum) interference from input signals.

If the preamplifier is pulled out, a switch with settings marked OFF, −20 dB, and −40 dB can be seen (Fig. 2-12).

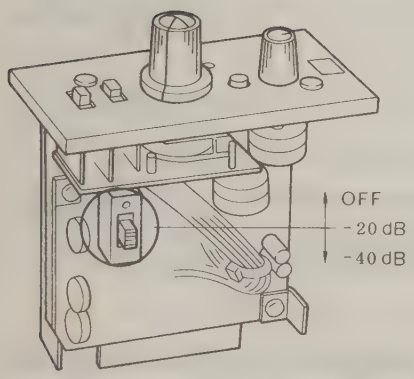


Fig. 2-12

If this switch is set to −20 dB or −40 dB, then the noise component will be reduced to 1/10 or 1/100, respectively. The noise filter is built into the AL3301 and AH3301. The following information gives the standard characteristics of the WR3310 Linearcorder. (The OFF, −20 dB, −40 dB markings are found on the left side of the CH2 input terminal inside the cover on the back panel (Fig. 2-13).)

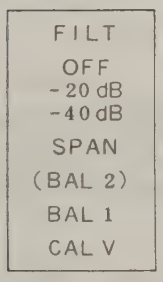


Fig. 2-13

The rear panel can be removed by removing the four holding screws. (Fig. 2-14)

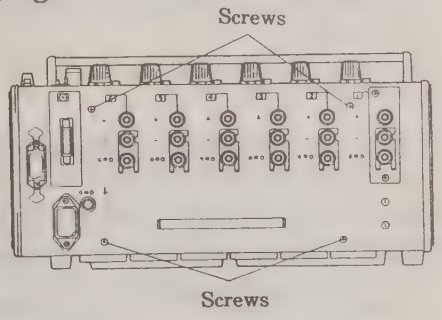


Fig. 2-14

3. MEASUREMENT AND RECORDING

3.1 Input Waveform Recording

Use the following procedures to measure and record input waveforms.

Inspection Prior to Power Application

Make the following checks before applying power to the system.

① The supply voltage selector must be set to the appropriate value for the line voltage used.

② The HEAT switch should be turned off (not depressed).

③ The STOP switch should be set to STOP (depressed).

④ The CHART EXT switch should be turned off (not depressed).

⑤ Power cable and signal cables should be correctly connected.

Power Application

Press the POWER switch on the operating panel and lock it. Power is now applied and the red indicator lamp lights.

Paper Feed Speed Setting

Use the CHART SPEED switch to select a paper feed speed that will allow the waveforms of the signal under measurement to be recorded.

Zero Point Setting

Turn the pen motor on/off switch for the channel being used on, then turn the POWER switch on, and release the paper feed STOP condition. Paper will now begin to be fed slowly, and the POSITION dial will be set so that the pen follows it.

Turn the POSITION dial so that the pen is aligned to an appropriate position, and if the MEAS/OFF switch is now set to MEAS, then the pen will be deflected according to the input signal.

RANGE Setting

Use the RANGE dial and the mV/V (mV/×100 mV) switch to steadily increase sensitivity and set an appropriate amplitude.

Next switch the CHART SPEED switch to the desired speed, and then immediately turn the HEAT switch on. Now recording will begin.

If necessary, turn the pen-motor HEAT CONT dial to adjust the density of the recorded lines.

Note

If at first the character of the input is not known, start sensitivity from the minimum level.

3.2 Sensitivity Fine Tuning and Calibration

Sensitivity Fine Tuning

In order to interpolate between neighboring settings on the RANGE dial, the GAIN knob can be rotated for fine adjustment of sensitivity while recording is in progress.

Sensitivity Calibration

To calibrate amplitude, set the preamplifier MEAS/OFF/CAL.V switch to off, align the pen to the zero line, and then set the switch to CAL.V. Now turn the GAIN knob so that the pen is deflected 20 mm (40 mm).

To correctly calibrate amplitude, set the RANGE switch to 500 mV/cm (AL3301 and AH3301), or to 250 mV/cm (AL3302 and AH3302), switch the input to the reference voltage terminal (5) on the top panel, and then turn the GAIN knob so that the pen is deflected 20 mm or 40 mm, respectively.

3.3 Marker Operation

Event Marker

Recording is performed on the marker side while the EVENT switch on the control panel is depressed.

Time Marker

Set the desired mark frequency using the TIMING dial on the control panel.

The time marker is started by turning the HEAT switch on.

While recording is in progress, the time marker cannot be updated by operating the TIMING (PULSE), or CHART SPEED switches, by changing the SPEED switch setting, or by fast feeding paper.

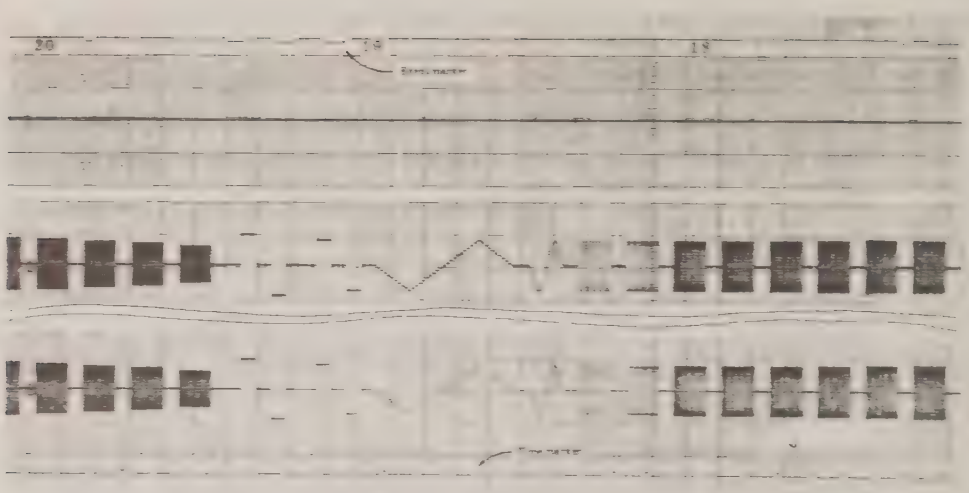


Fig. 3-1 Marker Printing Examples

3.4 Printer Operation

A print head can be used with the WR3310 to record character data.

There are two modes for printing character data, the internal mode, in which internal data is automatically printed, and the external mode, in which character data from an external digital device is printed. The internal mode is explained below. Refer to Section 4.2.1 for details on the external mode.

There are two types of internal modes, the normal and real modes.

Normal Mode

In the normal mode, the year, month, and day, power up time, and paper feed speed are automatically printed.

For the power up time, the time point at which power is applied is set to 00h, 00min, 00s, and power up time is calculated from there. If power up time exceeds 24 hours, the count returns to 00h, 00min, 00s and starts again from there, but note that in this case, the date is not updated.

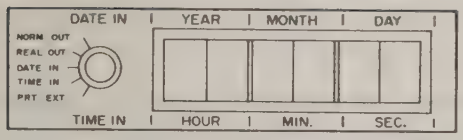
Procedure

① Turn the power switch off, or stop paper feed.

② Set the printer mode switch to NORM OUT.

③ Set the year, month, and day data (two digits each) with the thumbwheel switches starting from the left. The set data is printed out as is.

Example



1988	January	1st
YEAR	MONTH	DAY
8 8	0 1	0 1

④ Now turn the power on (switch depressed) or if paper feed was suspended, start paper feed again.

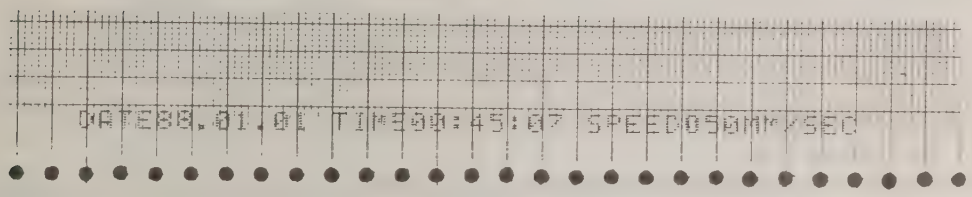
⑤ Set the paper feed speed.

⑥ Turn on the HEAT switch (depressed) to initiate character printout.

The characters are printed out at intervals of approximately 450 mm of paper length.

Example

Set speed feed to 50 mm/s. If power is applied for 45 min, the printout is shown below.



PRECAUTIONS

① The data printed out is that established immediately prior to printing.

② Once printing begins, even if the data is changed using the thumbwheel switches or if paper feed speed is changed, the data actually printed out does not change.

③ When paper feed is controlled by external sync signals (when CHART EXT switch is depressed), printout is controlled by the EXTERNAL switch.

④ Characters are printed out only while paper is being fed and only if the HEAT switch is depressed.

⑤ Data used to control the printer is cleared when power is turned off.

Real Mode (REAL OUT)

In the real mode, year, month, day, time, and paper feed speed are automatically printed out.

The time is determined by an internal clock, so it has to be initialized. When the clock passes through 24 hours, the date is automatically updated. A backup battery is provided to keep the internal clock running when the power is turned off.

Procedure

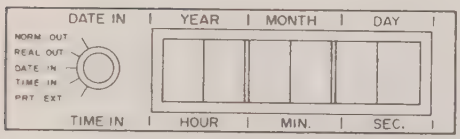
① Press the STOP switch (to lock it).

② Turn the POWER switch on (depressed).

③ Set the printer mode switch to TIME IN.

④ Set the time in hours, minutes, and seconds using the thumbwheel switches from the left (two digits each). The maximum number of hours that can be set is 24.

Example



13 o'clock	15 min.	00 s
HOUR	MIN	SEC
1 3	1 5	0 0

⑤ Press the PRINT SET switch. While this switch is depressed, data is read into the control computer, and time calculations begin.

⑥ Set the printer mode switch to DATE IN.

⑦ Set the year, month and day data (two digits each) using the thumbwheel switches from the left. The year is set using the last two digits, and leap year intercalation is performed automatically.

Example

1988	March	1st
YEAR	MONTH	DAY
8 8	0 3	0 1

⑧ Press the PRINT SET switch. Data is read into the control computer while this switch is depressed.

⑨ Set the printer mode switch to REAL OUT.

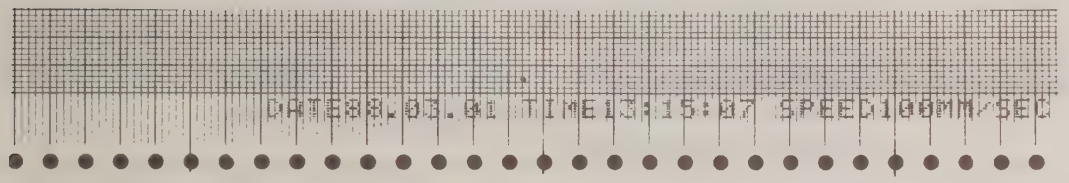
⑩ Select the paper feed speed.

⑪ Turn the HEAT switch on (depressed), and press the STOP switch to release the lock (not depressed). Paper will then start to be fed and characters will be printed.

Characters are printed at intervals of the length of the paper, approximately 450 mm.

Example

If feed is set at 100 mm/s, the print output is as follows.



⑫ Once signal waveform recording is completed, turn the POWER switch off (not depressed).

⑬ In order to perform recording again, after setting the printer mode switch to REAL OUT, turn the POWER switch on again (depressed). Then perform the operations starting with step ⑩ above. Date and time data storage is supported by battery backup, so it is automatically printed out.

⑭ To change date and time data, turn the HEAT switch off (not depressed), or set the STOP switch to STOP (depressed), and then to go step ③ above and start the procedure from there. It is also possible to change only the date or the time.

PRECAUTIONS

① The data printed out is that established immediately prior to printing.

② When paper feed is controlled by external sync signals (when the CHART EXT switch is depressed), printout is controlled by the EXTERNAL switch.

③ Characters can only be printed while paper is being fed if the HEAT switch is on (depressed).

④ Year data is specified by the last two digits of the year, and intercalation for leap years is performed automatically.

⑤ If month and day numerical values are not specified, the following processing is performed.

- When data is specified up to the 31st (e.g., 2/30) after calculating dates up to the 31st for that month, it is taken as the 1st for the following month.
- If day data is set at 32 or a higher numerical value (e.g., 2/35), the data is ignored, and the clock data is not changed.

⑥ If impossible hour and minute data is specified (e.g., 13h, 65 min), the data is ignored and the clock data is not changed.

4. CONTROL BY EXTERNAL SIGNALS

4.1 Recorder Control

The following operations can be carried out under control by external signals on the WR3310.

① Paper feed by pulse sequences

② Time marking by timing pulses

③ Event marking by event signals

④ HEAT on/off control

⑤ CHART start/stop control or signal output for passing data to external equipment

⑥ Paper out signal

⑦ Internal timing pulses

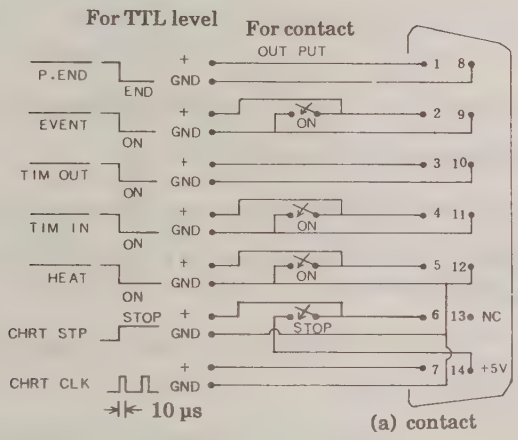


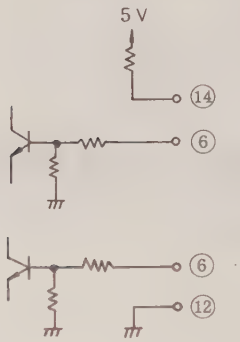
Fig. 4-1 External Control Connection

Signal Name	Input/Output	Operation
CHRT STP	Input	Paper feed suspended when +5 V (no. 14) is shorted or when high
CHRT CLK	Input	Paper is fed at pulse
HEAT	Input	Pen heater goes on when shorted to ground or low
EVENT	Input	Event mark printed when shorted to ground or when low
P. END	Output	Goes low when paper runs out or when pen is raised
TIM OUT	Output	Low at timing mark
TIM IN	Input	Timing mark printed at short to ground or when low

Table 4-1 External Control Signals

4.1.1 Paper Feed Stop (CHR. STP)

Paper feed can be stopped by control signals from an external device. When performing this control operation, the STOP switch must be set to off (not depressed).



- Contact Signal

  Connect the switches to control terminals ⑥ and ⑭.

  ON: Feed stops

  OFF: Feed starts

- TTL Level Signal

  Input signal to control terminals ⑥ and ⑫.

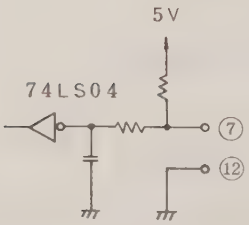
  L: Feed starts

  H: Feed stops

4.1.2 Paper Feed External Sync (CHR. CLK)

Paper can be fed in sync with an externally supplied signal.

When performing this control, the CHART EXT switch must be set to EXT (depressed).



- Contact, open-collector, TTL-level signal

  Input the signal to control terminals ⑦ and ⑫.

  Paper is fed 0.025 mm each time the sequence H→L is repeated.

  Maximum frequency: 2000 pps (2000 x/s)

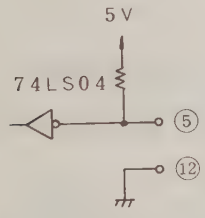
  Pulse width: 10 μs minimum

  Feed quantity: 0.025 mm/pulse

4.1.3 Recording On/Off (HEAT ON)

Recording on/off control can be performed by an externally supplied signal.

When this control is performed, the HEAT switch must be set to off (not depressed).



- Contact, open-collector, TTL-level signal

  Input the signal to control terminals ⑤ and ⑫.

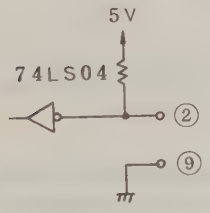
  L, on: Record (power supplied to pen.)

  H, off: Do not record (power is not supplied to pen.)

4.1.4 Event Marker (EVENT)

Event marks can be recorded according to externally supplied signals.

When this control is performed, the TIMING switch is set to EVENT.



- Contact, open-collector, TTL-level signal

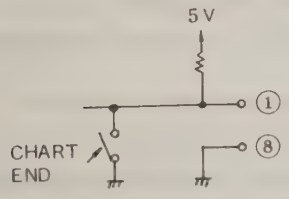
  Input the signal to control terminals ② and ⑨.

  L, on: Record EVENT mark

  H, off: Record EVENT baseline

4.1.5 Paper Out Signal Output (CHR END)

The control signal for paper out or pen up conditions is output between ① and ⑧.



L: No paper remains. Or pen is up.

(Recording cannot be performed.)

H: There is paper remaining, and the pen is down.

(Recording can be performed.)

4.1.6 Timing Signal Output (TIM OUT)

When recording timing marks, the signals are output.

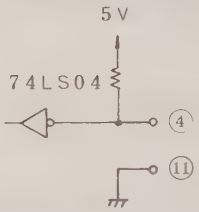
If these are connected to the timing input of another recorder, they can be used as the references for waveform analysis. They are output between ③ and ⑩.

L: Timing mark

H: Timing mark baseline

4.1.7 Timing Input (TIM IN)

This is used when it is desired to sync the timing marker. The timing marker is set to EXT. The signal is input to ④ and ⑪.



L: Timing mark

H: Timing mark baseline

4.2 Print Control from External Equipment

4.2.1 Printer (External Mode A)

The WR3310 printer can print character data received from external digital equipment.

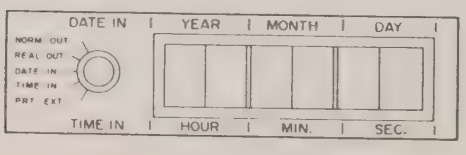
Character data from external equipment can be printed in external mode A, in which the character data is printed without change while the system is printing in the internal mode, or in external mode B, in which internal mode data and external character data are selectively printed according to command specifications.

- External Mode A Operation

After printing internal data in either the normal or real modes, character signals are accepted from the external equipment and printed out.

CAUTIONS

- In external mode A operation, the character signals from the external equipment (in ASCII code) are printed without change.
- Signals cannot be accepted from external devices while the system is printing in the internal mode.



- External Mode A Setting Method

Set the printer mode switch to NORM OUT or to REAL OUT.

- Character Signal Length and Character Printing

① Signals for less than 11 characters + terminator

11 characters or less	(term)

Characters are printed up to the terminator.

② Signals for more than 13 characters + terminator

13 characters or more	(term)

As data for 12 characters is accumulated in the buffer memory, the 12 characters are printed out, and subsequently the characters are printed out each time data for 12 characters is received. This is repeated until the terminator is received.

③ Signals for less than 11 characters only

11 characters or less	(no term)

Data is written into the buffer memory, but recording is not performed. Subsequently, internal data is also not recorded.

④ Signals for more than 13 characters only

13 characters or more	(no term)

Once data for 12 characters is accumulated in the buffer memory, those 12 characters are printed out, and subsequently the remaining data is written into the memory. Data is printed out each time 12 characters are accumulated, but if only 11 characters or less are received, printing is not performed. Internal data is also not printed out.

CAUTION

It is extremely important to ensure that the terminator is output at the end of the character data. If there is no terminator, printing will not be performed.

- Interface

An eight-bit parallel interface is used for the printer. The connector pin layout and signal reception timing chart are given below.

B		A
BUSY	8	DATA0
$\overline{ACK}$	7	DATA1
N.C.	6	DATA2
GND	5	DATA3
GND	4	DATA4
$\overline{BUSY}$	3	DATA5
DATA7	2	DATA6
+5 V	1	STROBE

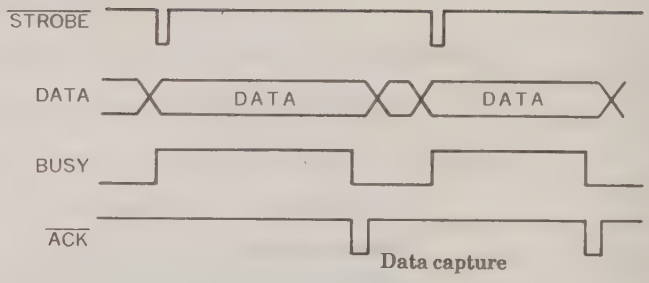


Fig. 4-2 Printer Connector

- Character Code Table

The printer code table is as follows.

Row line	00	···	02	03	04	05	···	11	12	13	···
0	NUL		SP	0	@	P		−	タ	ミ	
1	TC_1 (SOH)		!	1	A	Q		ア	チ	ム	
2	TC_2 (STX)		〃	2	B	R		イ	ツ	メ	
3	TC_3 (ETX)		#	3	C	S		ウ	テ	モ	
4	TC_4 (ECT)		$	4	D	T		エ	ト	ヤ	
5	TC_5 (ENQ)		%	5	E	U		オ	ナ	ユ	
6	TC_6 (ACK)		&	6	F	V		カ	ニ	ヨ	
7	BEL		'	7	G	W		キ	ヌ	ラ	
8	FE_0 (BS)		(	8	H	X		ク	ネ	リ	
9	FE_1 (HT)		)	9	I	Y		ケ	ノ	ル	
10	FE_2 (LF)		*	:	J	Z		コ	ハ	レ	
11	FE_3 (VT)		+	;	K	[		サ	ヒ	ロ	
12	FE_4 (FF)		,	<	L	¥		シ	フ	ワ	
13	FE_5 (CR)		−	=	M	]		ス	ヘ	ン	
14			.	>	N	↑		セ	ホ	゛	
15			/	?	O	←		ソ	マ	°	

Note

Row 00 characters are all processed as terminators.

4.2.2 Printer (External Mode B)

Printing is performed under control of commands from external equipment in printer external mode B. Commands determine selective printing of internal data or specification of data to the clock. It is also possible to print character data from the external equipment.

- External Mode Operating Procedure

  Use the following procedure to make settings for the external mode B.

  ① Set the STOP switch to STOP (depressed), or set all HEAT switches to off (not depressed).

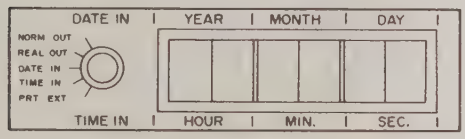
  ② Set the print mode switch to PRT EXT.

  ③ Set the STOP switch to off (not depressed), and printing will start.

  ④ Input commands from the external equipment.

- Command Table

  The following commands can be used for printer control.



Command Name	Command Format	Function
DATA SET	DS××,××,×× CR/LF	Makes year, month, and day clock settings.
TIME SET	TS××,××,×× CR/LF	Makes hour, minute, and second clock settings.
PRINT FORMAT	PFn CR/LF (n=00 to 15)	Sets print format
PRINT REPEAT LENGTH	PLn CR/LF (n=0 to 3)	Sets print repetition cycle
DATA NO. SET	DNn CR/LF (n=00 to 99)	Sets data number
DATA NO. UP/DOWN	DMn CR/LF (n=0 to 2)	Increases or decreases data number
LABEL	LB_{C1} to $_{C12}$ CR/LF	Inputs characters to be printed
LABEL PRINT	LP CR/LF	Prints input characters

CAUTIONS

- Input all commands as upper case ASCII characters. Refer to the character code table above.
- Command DS and TS data (× in the table above) are exclusively numerical values. Dates are accepted up to the 31st for each month. Data for month, hour, minute, and second is ignored if it is invalid (e.g., 13 (mo.)/25(h)/70 (min)/80 (s)).

The commands are described below.

- DATE SET

This command is used to set the year, month and day. Each item is specified as 2 digits, using commas to separate them. Year is specified by the last two digits of the year, and intercalation for leap years is performed automatically.

Example

April 1, 1988

DS 88 , 04 , 01 CR/LF

Data

Coded in BASIC:

```
LPRINT "DS88 , 04 , 01"
```

- TIME SET

This is used to specify the hour, minute, and second data. These are all specified as two digits, and separated by commas. The hour data is specified according to the 24-hour clock.

Example

15 h, 13 min., 24 s

TS 15 , 13 , 24 CR/LF

Data

- PRINT FORMAT

This command is used to select internal mode printing. Specify internal parameters to select the date, time, speed, and data number according to the table below and to print them out as such. Parameters are specified as two digits. Up to 15 parameters can be specified, from the 16th on they are ignored.

Parameter	Print Format				
	DATA	TIME	SPEED	NO.	
00	–	–	–	–	Internal data is not printed
01	–	–	–	○	Print number
02	–	–	○	–	Print speed
03	–	–	○	○	Print speed and number
04	–	○	–	–	Print time
05	–	○	–	○	Print time and number
06	–	○	○	–	Print time and speed
07	–	○	○	○	Print time, speed and number
08	○	–	–	–	Print date
09	○	–	–	○	Print date and number
10	○	–	○	–	Print date and speed
11	○	–	○	○	Print date, speed and number
12	○	○	–	–	Print date and time
13	○	○	–	○	Print date, time and number
14	○	○	○	–	Print date, time and speed
15	○	○	○	○	Print date, time, speed and number

The default value (initial value) for the parameter n is 00.

Example

Plot only time and speed.

PF 06 CR/LF

Parameter n

- PRINT REPEAT LENGTH

This command is used to select the repetition length (interval) of printing in the internal mode. The length corresponds to the values of input parameters as shown in the table below. The parameter is a single digit numerical value, and values greater than 4 are ignored.

Parameter	Repetition Length
0	Print in internal mode each time paper is fed 450 mm
1	Print in internal mode each time paper is fed 300 mm
2	Print in internal mode each time paper is fed 200 mm
3	Print in internal mode each time paper is fed 150 mm

The default value (initial value) of the parameter n is 0.

Example

Printout after every 200 mm of paper fed.

PL 2 CR/LF

Parameter

- DATA No. SET

This command is used to specify the data number. It is a two-digit numerical value.

Example

Set the data number to 56.

DS 56 CR/LF

Data

- DATA No. UP/DOWN

This command is used to increase or decrease the data number. Depending on the input parameter, the data number is increased or decreased automatically each time it is printed.

Parameter	Increase/Decrease of Data No.
0	Data No. unchanged
1	Data No. incremented by 1 (when number is 99, incremented to 00.)
2	Data decremented by 1 (when number is 00, decremented to 99.)

The default value (initial value) for the parameter n is 0.

Example

Change the data number 56 to 57. (Addition)

DM 1 CR/LF

Parameter

- LABEL

This command is used to input print characters. Input print characters in ASCII code. Up to 12 characters can be input, and all characters from the 13th onward are ignored.

Example

Print 「A B C 1 2 3 D E F」

L B A B C 1 2 3 D E F CR/LF

Characters

- LABEL PRINT

  This command is used to print the characters input using the LABEL command. If this command is not input, input characters are merely stored in memory, but not printed out.

  Example

  Print「A B C 1 2 3 D E F」

  L B A B C 1 2 3 D E F CR/LF (character input)

  L P CR/LF (execute print)

CAUTION

The LP command has priority over the PF and PL commands.

That is, while characters are being printed out under the LP command, when the point at which internal mode printing is to be done under the PL command is reached, characters specified with the LP command will continue to be printed out.

The characters specified by the PL command will be printed out subsequently in the internal mode.

5. SPECIFICATIONS

5.1 Linearcorder Specifications

Pen Motor	GS3310	GW3310
No. of channels	2/ 4/6/8/12	1/2/3/4/6
Amplitude	±20 mm	±40 mm
Recording method	Thermal recording (in black or blue)	
Input format	Floating ground with guard shield	
Circuit format	DC servo	
Input resistance	Potentiometric	
Sensitivity	±2.5 V/20 mm	±2.5 V/40 mm
Accuracy	Within ±0.5% of full scale (including non-linearity and deadband)	
Frequency characteristics (1 Hz reference)	10 mm p-p : 0 to 140 Hz (+5 · −10%) 20 mm p-p : 0 to 100 Hz (+5 · −10%) 40 mm p-p : 0 to 60 Hz (+5 · −10%)	20 mm p-p : 0 to 60 Hz (+5 · −10%) 40 mm p-p : 0 to 45 Hz (+5 · −10%) 80 mm p-p : 0 to 30 Hz (+5 · −10%)
Reference voltage	1 V (accuracy: ±0.2%)	
Paper feed speed	5, 10, 25, 50, 100, 250, and 500 mm/s or mm/min, and EXT (50 mm/s max) accuracy: ±0.2%, ±0.5mm)	
Time marker	One mark each 1 or 10 s or 1 or 10 min (accuracy: ±0.1%), and remote control by external contact short or TTL level.	
Event marker	Pushbutton operation, or external contact short, or remote control by TTL level	
Remote paper feed	External contact short, or remote on/off by TTL level	
Remote pen heater	External contact short, or remote on/off by TTL level	
Rewinding paper	100 mm/s (only for roll paper)	
Printing	Internal printing: year, month, day, and power up time, or time, date and no., and feed speed External printing: external ASCII characters, alphanumeric characters, and symbols	
Power requirements	100 VAC (with 117, 220, and 240 V selector) ±10%, however, voltage is specified (50 or 60 Hz common) for one channel on the GW3101 and on 2 channels for the GS3101	

Power consumption (approx.) L(H): at 10 mmp-p and 120 Hz DL (DH): at 20 mmp-p and 60 Hz	2L (H)	4L (H)	6L (H)	8L (H)	12L (H)	1DL (DH)	2DL (DH)	3DL (DH)	4DL (DH)	6DL (DH)
	185 VA	245 VA	305 VA	365 VA	485 VA	155 VA	185 VA	215 VA	245 VA	305 VA

Outer dimensions (mm) (common difference ±3 mm)	430(W) × 187(H) common									
	199 (D)	289 (D)	379 (D)	450 (D)	649 (D)	199 (D)	289 (D)	379 (D)	450 (D)	649 (D)
Weight (approx.)	13 kg	18 kg	24 kg	28 kg	41 kg	12 kg	16 kg	20 kg	23 kg	34 kg
Operating temp. range	0 to 45°C									
Operating humidity range	30 to 85%									

* Power consumption and weight include preamps.

5.2 Preamp Specifications

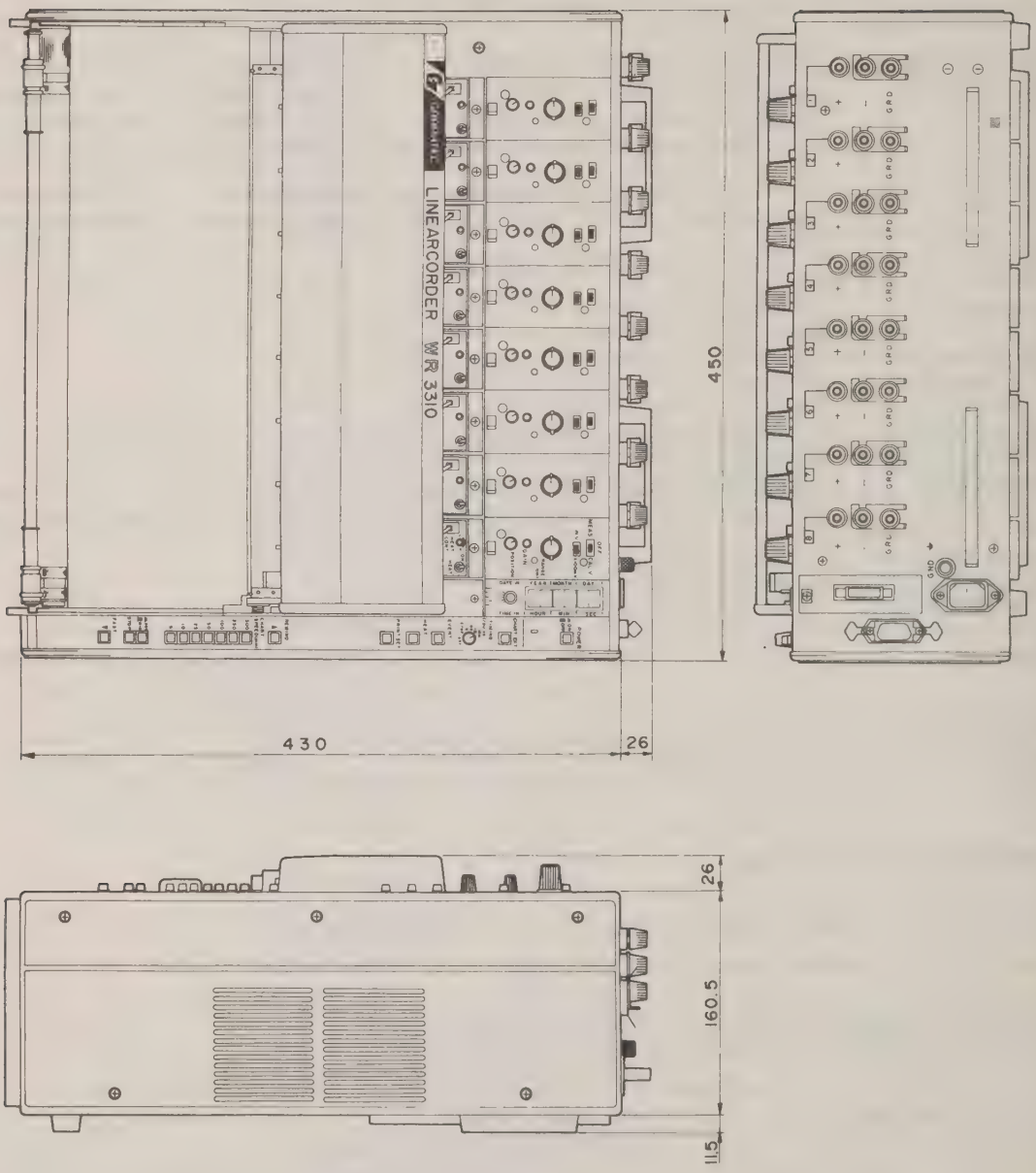
Model	AL3301	AL3302	AH3301	AH3302
Maximum sensitivity	5 mV/cm	2.5 mV/cm	1 mV/cm	0.5 mV/cm
Measurement range (switching accuracy)	5, 10, 20, 50, 100, 200, 500, 1000 mV 0.5, 1, 2, 5, 10, 20 · 50, 100 V/cm ±1% (reference range: 500 mV/cm)	2.5, 5, 10, 25, 50, 100, 250, 500 mV 0.25, 0.5, 1, 2.5, 5, 10, 25, 50 V/cm ±1% (reference range: 250 mV/cm)	1, 2, 5, 10, 20, 50, 100, 200, 500 mV 1, 2, 5, 10, 20, 50, 100, 200, 500 V/cm ±1% (reference range: 500 mV/cm)	0.5, 1, 2.5, 5, 10, 25, 50, 100, 250 mV 0.5, 1, 2.5, 5, 10, 25, 50, 100, 250 V/cm ±1% (reference range: 250 mV/cm)
Input format	Floating ground with guard shield			
Input resistance	1 MΩ, constant			
Maximum permissible input voltage	500 VDC (including in-phase voltage)			
Sensitivity adjustment	Continuously variable over measurement range			
Calibration voltage	Twice measurement range (20 mm)	Four times measurement range (40 mm)	Twice measurement range (20 mm)	Four times measurement range (40 mm)
Pen position adjustment	Can be set to any desired position in full scale			
Common-mode rejection	DC : 130 dB · AC : 110 dB		DC : 140 dB · AC : 120 dB	
Input filter			Built in (switch can be set to 50 Hz, 60 Hz, or off, when on, frequency characteristic is 0 to 5 Hz)	
Pen motor	GS3310	GW3310	GS3310	GW3310

5.3 Standard Accessories

Item	No.	Item	No.
Instruction Manual	1	Accessory bag	1
Paper	1 roll (box)	Power cord	1
Input cable	1 for each channel	* Fuses: 4 A (2 to 6 elements), 6 A (8 to 12 elements)	2
Vinyl cover	1	Print connector	1
Phillips screwdriver	1	Remote connector	1
Flathead screwdriver	1	Calibration signal cable	1
L-type set wrench	1		

* For 220 or 240 VAC, 2 A (2 to 6 elements), 3 A (8 to 12 elements)

6. OUTER VIEWS



INSPECTION CERTIFICATION

This product was manufactured under a strict program of quality control and has passed severe inspections. Inpsections were performed at normal room temperature and humidity after the unit's circuitry was allowed to stabilize.

Inspector: _____

The specifications in this manual are subject to change without prior notice.

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